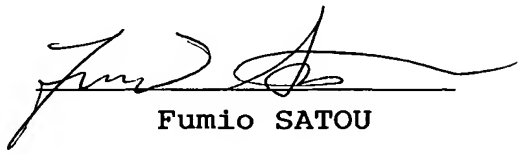
Declaration

I, Fumio SATOU, a national of Japan, who works for Nitto International Patent Office P.P.C., 8th floor No. 17 Arai Building, 3-3, Shinkawa 1-chome, Chuo-ku, Tokyo 104-0033, Japan declare that to the best of my knowledge and belief the attached is a true translation made by me of the annexed document which is Japanese Patent Application No. 2002-224329, filed on August 1, 2002, and further declare that the contexts of the translation and the Japanese document are the same.

I hereby declare that all statements made by me of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signed this 10th day of July, 2006



Fumio SATOU

[NAME OF DOCUMENT] SPECIFICATION

[TITLE OF THE INVENTION] ELECTRONIC DEVICE

[WHAT IS CLAIMED IS]

[Claim 1]

An electronic device storing and protecting in a case member an insulating substrate and an electronic substrate having an electronic circuit composed of mounted parts such as conductors, resistors, and capacitors which are formed in a film form on said insulating substrate, wherein:

said film-form conductors formed on said surface of said insulating substrate excluding a probing portion for electrically connecting with said conductors in a manufacturing process of said electronic device and a mounting portion which is connections of said conductors with said mounted parts are overcoated with glass or resin, and openings of said probing portion and said mounting portion which are not overcoated are all formed in a shape having no corners at 90° or less, for example, in a circular shape, in an elliptical shape, or in a shape that corners of a tetragon are rounded (R, circular arc) or chamfered (C, tapered), and said openings surrounded by said overcoating materials are covered with solder or metallic paste.

[Claim 2]

An electronic device storing and protecting in a case member an insulating substrate and an electronic substrate having an electronic circuit composed of mounted parts such as conductors, resistors, and capacitors which are formed in a film form on said insulating substrate, wherein:

said film-form conductors formed on said surface of said insulating substrate are mostly overcoated with an overcoat material of glass or resin, and the remainder is overcoated with a conductive member such as solder or metallic paste, and the surface of said overcoated part by solder or metallic paste is formed in a shape having no corners at 90° or less, for example, in a circular shape, in an elliptical shape, or in a shape that corners of a tetragon are rounded (R, circular arc) or chamfered (C, tapered).

[Claim 3]

An electronic device according to Claim 1, wherein the shape of said overcoated part by solder or metallic paste is a tetragon having a ratio of the short side to the long side within the range from 0.5 to 1.5 or an ellipse.

[Claim 4]

An electronic device according to Claim 1, wherein

the shape of said overcoated part by solder or metallic paste is a tetragon that said corners are rounded at R or C of 1/10 of the long side or more.

[Claim 5]

An electronic device according to Claim 1, wherein the shape of said overcoated part by solder or metallic paste is a tetragon that said corners are rounded at R or C between 0.1 and 0.5.

[Claim 6]

An electronic device storing and protecting in a case member an insulating substrate and an electronic substrate having an electronic circuit composed of mounted parts such as conductors, resistors, and capacitors which are formed in a film form on said insulating substrate, wherein:

said film-form conductors formed on said surface of said insulating substrate excluding a probing portion for electrically connecting with said conductors in a manufacturing process of said electronic device and a mounting portion which is connections of said conductors with said mounted parts are overcoated with glass or resin and said probing portion or said mounting portion is subject to a conductor pattern that said portion is formed in a position branched from a conductor line where the

function of said electronic circuit is not damaged even if said portion is disconnected or said conductors are formed in parallel.

[Claim 7]

An electronic device according to Claim 6, wherein as means for forming said conductors in parallel, said conductors are formed in a multilayer on said substrate, and said probing portion or said mounting portion is formed in the uppermost layer, and said conductors in the lower layers are arranged in parallel with said portion.

[Claim 8]

An electronic device according to Claim 6, wherein:

said film-form conductors formed on said surface of said insulating substrate excluding a probing portion for electrically connecting with said conductors in a manufacturing process of said electronic device and a mounting portion which is connections of said conductors with said mounted parts are overcoated with glass or resin and in said probing portion or said mounting portion, the conductor width is wider than that of the other parts and the width of unovercoated opening faces is 2/3 of said conductor width or less.

[Claim 9]

An electronic device according to Claim 1, wherein said case member is a joint of a member having a conductive terminal for electrically connecting said electronic substrate positioned in said case to an outside of said case and a member such as a cover, and said joint is formed via an adhesive, fusing, or sealing material, thus an airtight case member is obtained.

[Claim 10]

An electronic device according to Claim 1, wherein said conductors are composed of a main component of silver or copper.

[Claim 11]

An electronic device according to Claim 1, wherein said insulating substrate is made of ceramics, and said conductors and said resistors are formed by thick film printing, and said coating is formed by thick film printing of glass, and said probing portion and said mounting portion are printed with solder, and after loading said mounting parts, said solder is heated and fused, that is, so-called reflowed.

[Claim 12]

An electronic device according to Claim 11, wherein the print film thickness of said solder is 5

times or more of said overcoated glass film thickness.

[Claim 13]

An electronic device according to Claim 11, wherein the print film thickness of said solder is 5 times or more of said print film thickness of said conductors.

[Claim 14]

An electronic device according to Claim 11, wherein said solder is composed of a main component of lead or tin.

[Claim 15]

An electronic device according to Claim 1, wherein said device is a thermal type air flow measuring instrument.

[Claim 16]

An electronic device according to Claim 15, wherein said thermal type air flow measuring instrument measures a flow rate of intake air into a car engine and is attached to an intake air passage.

[Claim 17]

An electronic device according to Claim 15, wherein whole or part of said case member for storing and protecting said electronic substrate is positioned in a flow path of a fluid to be measured.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Field of the Invention]

The present invention relates to the sealing structure of various sensors for outputting various physical quantities as electrical signals by an electronic device, particularly by a sensing element for detecting various physical quantities and an electronic circuit for controlling the sensing element which are installed in an engine room and the mounting structure of an electronic circuit concerning improvement of the corrosion resistance of an electronic circuit of an electronic device for car use having a microprocessor computer for controlling various states of a car upon receipt of electrical signals of the aforementioned various sensors.

[0002]

[Prior Art]

Various kinds of hybrid IC substrates having a thick film resistor printed on a ceramic substrate and loading parts such as a semiconductor integrated circuit, a capacitor, and a diode are known. Among them, for a hybrid IC substrate adopting conductor wires of silver, silver alloy, copper, or copper alloy, particularly for a hybrid IC substrate adopted in an electronic device for car use, corrosion of the

conductor wires due to corrosive gas is worried and as a corrosion improvement measure, coating the conductor wires with glass is considered. However, the resistors printed on a hybrid IC substrate and the mounted electronic parts are varied, and to provide a highly precise electronic device, the resistance and characteristics must be adjusted, and a conductor exposed part for that purpose is required. As a method for covering the exposed part, soldering is generally used. However, it is a method in consideration of contact at the time of probing instead of a target of improving the corrosion resistance, which is limited to a case necessary for probing. Further, even when soldering is adopted, there are many exposed parts of the conductor wires due to poor wettability of solder. As an improvement measure for solder wettability, as described in Japanese Application Patent Laid-Open Publication No. Hei 04-334083, an improving method by a process such as two-dimensional calcination is adopted.

[0003]

[Problems to be Solved by the Invention]

According to the prior art, the conductor wires constituting the circuit are not partially overcoated and the corrosion resistance is not satisfactory in

some environment. Further, even in a constitution of overcoating with solder, due to poor wettability of solder, the conductor wires and the ends of the mounting portion of a mounted part, particularly the corners are exposed and the corrosion resistance is not satisfied.

[0004]

An object of the present invention is to keep the function of the electronic circuit away from damage even if the opening is corroded and improve the corrosion resistance.

[0005]

[Means for Solving the Problems]

The above object can be accomplished by the invention stated in the claims. For example, to solve the aforementioned problem of corrosion resistance in an electronic device, for probing of resistance adjustment and characteristic adjustment, by use of a structure of overcoating the glass or resin coating opening with solder or metallic paste, the corrosion resistance can be improved. Further, the opening is formed in a shape having no corners at 90° or less, for example, in a circular shape, in an elliptical shape, or in a shape that the corners of a tetragon are rounded (R) or chamfered (C), thus the corrosion

resistance can be improved.

[0006]

Further, the opening is branched from the conductor line constituting the circuit or the conductors are formed in parallel, thus even if the opening is corroded, the function of the electronic circuit can be prevented from damage and the corrosion resistance can be improved.

[0007]

[Description of the Preferred Embodiments]

Firstly, a typical cross sectional structure of an electronic device for car use exposed to a severe corrosion environment as an electronic device is shown in Fig. 1. Further, by referring to Fig. 2 showing the corrosion environment to which the electronic device for car use is exposed, the structure of the electronic device for car use, use environment, and problems will be explained. The electronic device for car use is broadly divided into a fuel control unit for a sensor and a control unit and an ignition control unit for an igniter and a coil. The sensor detects physical quantities such as the intake air flow rate, air temperature, atmospheric pressure, and boost pressure, and the control unit has a function for receiving a signal of the sensor and controlling

the combustion state in the cylinders, and the igniter and coil have a function for controlling the ignition time in the cylinders. The common in the structures of these electronic devices for car use is that a structure that the respective electronic devices have an electronic driving circuit 1 or an electronic control circuit and are adhered and fixed to a metallic base 2 on which the electronic driving circuit 1 or the electronic control circuit is installed, and a base 3 for storing the electronic driving circuit 1 or the electronic control circuit is adhered and fixed (4) to the base 2, and moreover the top thereof is adhered and fixed (6) by a cover 5 is often used. For the electronic driving circuit 1 or the electronic control circuit, a hybrid IC substrate 9 which is formed by printing and calcining a conductor wire 8 as a conductor of the circuit and a resistor on the surface of a plane substrate 7 formed by an inorganic material such as ceramics and provided with a capacitor, a diode, and a semiconductor integrated circuit on the surface is often adopted and to promote heat dissipation from the hybrid IC substrate 9, the hybrid IC substrate 9 is adhered and fixed to the metallic base 2 by a silicone adhesive. Since the metallic base 2 serves as a heat sink for

heat dissipation, a metal having a high heat transfer rate, particularly aluminum is often used. The case 3 for storing the hybrid IC substrate 9 and the cover 5 for covering the top are formed integrally with the connector which is an interface for I/O signals of the electronic driving circuit 1 and a structure that a terminal 11 composed of a conductive member for controlling transfer of an electrical signal is inserted into the resin forming the case 3 is often used. In this case, the sensor for detecting the physical quantities such as the intake air temperature, intake air flow rate, and boost pressure is structured so as to install a sensing element 10 outside or in the case opening and electrically connected to the electronic driving circuit 1 via the terminal 11. The case 3 is adhered and fixed (4) to the base 2 and the cover 5 is also adhered and fixed (6) to the case 3. As resin materials for forming the case 3 and the cover 5, resins having superior injection moldability such as polyethylene terephthalate (PET), polyphenylene sulfide (PPS), nylon 6, nylon 66, nylon 11, and nylon 12 are adopted in many electronic devices for car use.

[0008]

In this case, the resin case 3 and metallic base 2

aforementioned are greatly different in the coefficient of linear expansion, so that an elastic adhesive having viscous elasticity like the silicone adhesive 12 is often used to adhere and seal them. Further, in most cases, an epoxy adhesive is used when the case 3 and the cover 5 are composed of the same member, while a silicone adhesive is used when they are composed of different members.

[0009]

For most electronic devices for car use explained above, an adhesive is often adopted for junction of components and the silicone adhesive 12 is often used.

[0010]

However, the silicone adhesive 12 has some faults due to the intrinsic properties of silicone resin. Inside the engine room of a car with an electronic device for car use loaded, combustion gas is blown back from the engine, and unburned gas is returned, thus the inside of the engine room is exposed to an atmosphere 13 of staying hydrocarbon. Further, the inside of the engine room is crowded with products such as a rubber duct and a hose containing sulfur which are often arranged in the engine components, thus the temperature of the electronic device inside the engine exceeds 100 °C. In this state, from the

products vulcanized by sulfur such as the rubber duct and hose, single sulfur gas or sulfur combined gas 14 is ejected. Further, these sulfur gases vary with the environment and may result in, as mentioned above, blow-back of combustion gas, return of unburned gas, or coexistence with the hydrocarbon 13, thus unless an electronic device for car use resistant to these corrosive gases is manufactured, there is the possibility that a highly reliable product may not be obtained. The reason is that in these electronic devices for car use, the conductor wires 8 formed on the plane substrate 7 of the electronic driving circuit 1 are often formed by silver or silver alloy, and when corrosive gas, particularly sulfur gas or the sulfur combined gas 14 enters the case 3, the silver, silver alloy, copper, and copper alloy wire parts of the conductor wires 8 are corroded, and there is the possibility that the conductor wires 8 of the electronic driving circuit 1 may be broken and the electronic driving circuit 1 may not be operated normally. Sulfide corrosion of the conductor wires 8 is generated in the exposed part of the conductor wires 8, so that we propose an electronic device for car use that the exposed part is covered with glass, resin, solder, or metallic paste, thus the function

for protecting the electronic driving circuit 1 from corrosive gas is improved.

[0011]

The sulfide corrosion countermeasure structure for an electronic device of the present invention will be explained hereunder.

[0012]

There are many kinds of electronic devices available and explanation for the all is difficult, so that as representation of an electronic device, the structure of the thermal type air flow measuring instrument for measuring the intake air flow rate shown in Fig. 3 and the embodiment thereof of the present invention will be explained hereunder. Firstly, the thermal type air flow measuring instrument will be explained briefly. Figs. 3 and 4 are cross sectional structure diagrams showing the structure of the thermal type air flow measuring instrument. The thermal type air flow measuring instrument is a sensor for measuring intake air. A heating resistor 15 of a thermal type air flow measuring instrument 17 using the heating resistor 15 and a temperature sensing resistor 16 is controlled by a constant temperature control circuit 18 so as to always keep a fixed temperature difference from the temperature sensing

resistor 16 for measuring the air temperature and heated always. The heating resistor 15 and the temperature sensing resistor 16 are arranged in an air cleaner for leading air to be sucked into the engine or an air duct installed on the downstream side of the air cleaner and structured so as to transfer an electrical signal via the constant temperature control circuit 18 and the conductive member 11 embedded in the case 3. In the thermal type air flow measuring instrument aforementioned, the base 2 for diffusing self-generated heat of a power device such as a power transistor is a structural substrate. To the base 2, the hybrid IC substrate 9 that the conductor wires 8 and resistors are printed on the front or back of the plane substrate 7 and additionally the semiconductor integrated circuit, power transistor, capacitor, inductor, and diode are mounted is adhered with a silicone adhesive. Further, the case 3 as a substrate for storing the hybrid IC substrate 9 that the connector, which is an interface unit for transferring a sensor signal to the outside or supplying circuit driving power from the outside, is formed simultaneously is adhered and sealed on the base 2 with the silicone adhesive 12, and then the top of the case 3 is covered with the cover 5 and sealed with a

silicone adhesive or an epoxy adhesive. In the hybrid IC substrate 9, the printed resistors and conductor wires 8 are coated with glass or resin. However, for adjustment of the resistances of the printed resistors and also for adjustment of the characteristics such as output, a probing portion capable of probing which is electrically connected to the conductor wires 8 must be installed and the probe makes contact with the probing portion so as to adjust the characteristics. As described above, when the silicone adhesive 12 adopted to mutually adhere many members has high gas permeability and is in a corrosion environment, corrosive gas is transmitted into the case 3 through the adhered and fixed portion 4. Further, corrosive gas enters from the air hole installed in the connector of the case 3. Therefore, to prevent the situation causing corrosion to the conductor wires 8 of the hybrid IC substrate 9 and mounted parts in the case 3, the probing portion necessary for adjustment which is installed in the hybrid IC substrate 9 or the exposed part of the conductor wires is devised, and the conductor wires 8 are prevented from corrosion due to corrosive gas, thus an electronic device including a thermal type air flow measuring instrument which is highly reliable in corrosion resistance can be

manufactured.

[0013]

Concretely, the probing portion of the hybrid IC substrate 9 is coated with solder or metallic paste, thus the contact of corrosive gas with the conductor wires 8 is reduced and the corrosion resistance can be improved. Further, by coating the exposed part of the conductor wires 8 with glass or resin after adjustment of the resistance and characteristics, the same effects can be obtained.

[0014]

When the probing portion is to be installed on the hybrid IC substrate 9, it is effective to form an opening by overcoating glass or resin and coat the opening with a conductive metal such as solder or metallic paste. However, in this case, when the wettability of solder or metallic paste to the conductor wires is poor, the conductor wires at the ends, particularly in the corners are exposed and may be corroded by corrosive gas. Therefore, the surface of the coating portion by solder or metallic paste is formed in a shape having no corners at 90° or less, for example, in a circular shape, in an elliptical shape, or in a shape that the corners of a tetragon are rounded (R, circular arc) or chamfered (C, tapered),

thus exposure of the corners at the ends of the conductor wires can be reduced and the corrosion resistance can be improved. In a case of a tetragon, it is desirable to set the ratio of the short side to the long side between 0.5 and 1.5 and R and C of the corners respectively between R0.1 and R0.5 and between C0.1 and C0.5.

[0015]

Further, when the wettability of solder or metallic paste to the mounting portion for mounting the components such as the capacitor, inductor, and diode on the hybrid IC substrate 9 is poor, the conductor wires at the ends, particularly in the corners are exposed and may be corroded by corrosive gas, so that when the corners of the exposed part 22 of the conductor wires 8 for mounting the parts are rounded (R) or chamfered, the corrosion resistance can be improved. At this time, the magnitude of R of the corners is preferably between R0.1 and R0.5 and the magnitude of chamfering is preferably between C0.1 and C0.5.

[0016]

Further, the conductor wires are formed under the components such as the capacitor, inductor, and diode to be mounted, thus the corrosion resistance can be

improved.

[0017]

Further, by the conductor pattern that the probing portion or the mounting portion is formed in a position branched from the conductor line where the function of the electronic circuit is not damaged even if the portion is disconnected or the conductors are formed in parallel, the corrosion resistance can be improved. When the conductor wires are formed in a multi-layer such as 2 or more layers, the top and bottom of the probing portion are connected by conductor wires 24 formed under an insulator 25 such as glass, thus even if the exposed part of the conductor is corroded, the conductor wires are connected by the lower layer, and the circuit constitution is kept, so that the corrosion resistance can be improved.

[0018]

Further, conductor wires 26 on the outermost side which is formed outside the ceramic substrate 9 are often given an opportunity of application of stress at the manufacture stage and in the actual use state and apt to be damaged compared with the conductor wires formed internally, so that the conductor width on the outermost side is made wider than the inside conductor

width, thus the corrosion resistance can be improved. When the conductor width on the outermost side is made two times or more of the inside conductor width, the corrosion resistance can be improved more.

[0019]

[Advantages of the Invention]

According to the present invention, the conductor wires can be prevented from corrosion in a corrosion resistant environment to which the hybrid IC substrate is exposed.

[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 is a cross sectional schematic view of an electronic device for car use showing the characteristics of the present invention.

Fig. 2 is a drawing showing an example of an environment where an electronic device for car use is put.

Fig. 3 is a structural diagram of a thermal type air flow measuring instrument.

Fig. 4 is a cross sectional schematic view of a thermal type air flow measuring instrument.

Fig. 5 is a schematic view of an electronic circuit substrate.

Fig. 6 is a drawing showing an example of a probing portion of an electronic circuit substrate.

Fig. 7 is a drawing showing an example of a probing portion of an electronic circuit substrate.

Fig. 8 is a drawing showing an example of a probing portion of an electronic circuit substrate.

Fig. 9 is a drawing showing an example of a probing portion of an electronic circuit substrate.

Fig. 10 is a drawing showing an example of a probing portion of an electronic circuit substrate.

Fig. 11 is a drawing showing an example of a probing portion of an electronic circuit substrate.

Fig. 12 is a drawing showing an example of a probing portion of an electronic circuit substrate.

Fig. 13 is a drawing showing an example of a probing portion of an electronic circuit substrate.

Fig. 14 is a drawing showing an example of a probing portion of an electronic circuit substrate.

Fig. 15 is a cross sectional structure diagram of an electronic circuit substrate.

Fig. 16 is a drawing showing an example of a probing portion of an electronic circuit substrate.

Fig. 17 is a cross sectional structure diagram of an electronic circuit substrate.

Fig. 18 is a cross sectional structure diagram of an electronic circuit substrate.

[Legend]

1: Electronic driving circuit, 2: Base, 3: Case, 4, 6: Adhering and fixing, 5: Cover, 7: Plane substrate, 8: Conductor wires, 9: Hybrid IC substrate, 10: Sensing element, 11: Terminal, 12: Silicone adhesive, 13: Corrosive gas of NOx or HC such as combustion gas, unburned gas, and hydrocarbon, 14: Sulfur combined gas, 15: Heating resistor, 16: Temperature sensing resistor, 17: Thermal type air flow measuring instrument, 18: Constant temperature control circuit, 19: Sub-path, 20: Intake air temperature sensor, 21: Probing portion, 22: Exposed part of conductor wires, 23: Resistor, 24, 26: ~~Conductor~~ wires, 25: Insulator such as glass, 27: Solder

[NAME OF DOCUMENT] ABSTRACT OF THE DISCLOSURE

[Abstract]

[Subject]

The present invention provides a highly reliable electronic device for car use that the conductor wires are prevented from corrosion.

[Means for Solving the problems]

The conductor wire surface for constituting a circuit formed by print or junction on a substrate formed from a composite member of ceramics, resin, and an inorganic member and from a resin member is coated with glass, resin, solder, or silver paste, thus the corrosion resistance can be improved, and a highly reliable electronic device for car use can be provided. Further, the probing portion necessary for adjustment of the resistance and characteristics and the mounting portion for mounting parts are formed in a shape having no corners at 90° or less, for example, in a circular shape, in an elliptical shape, or in a shape that the corners of a tetragon are rounded (R) or chamfered (C).

[Selected Figure] Fig. 5

FIG. 1

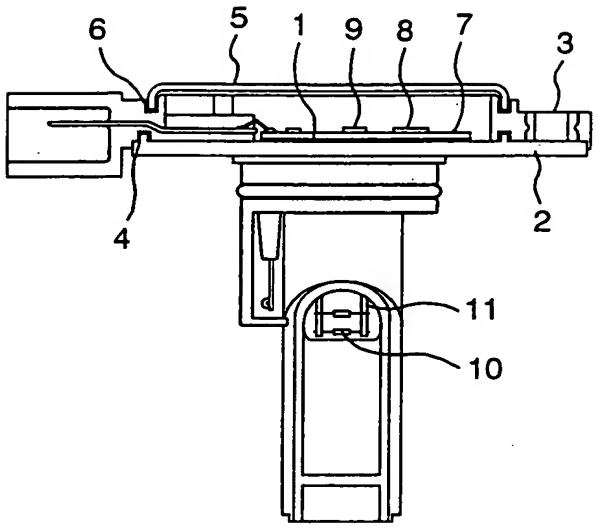


FIG. 2

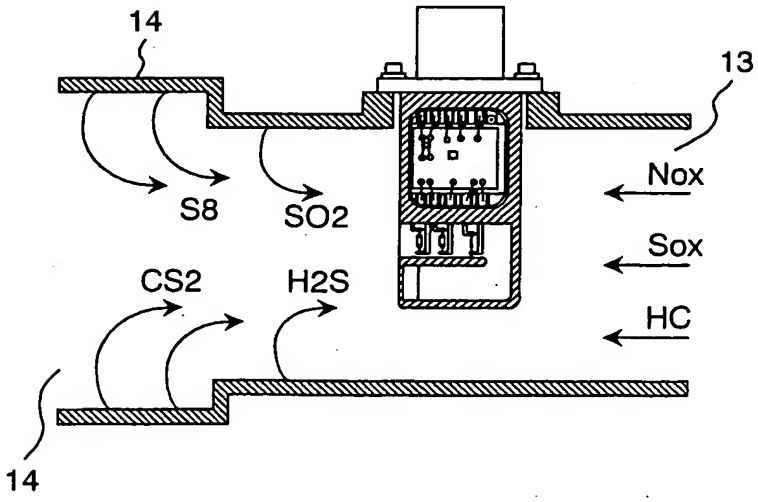


FIG. 3

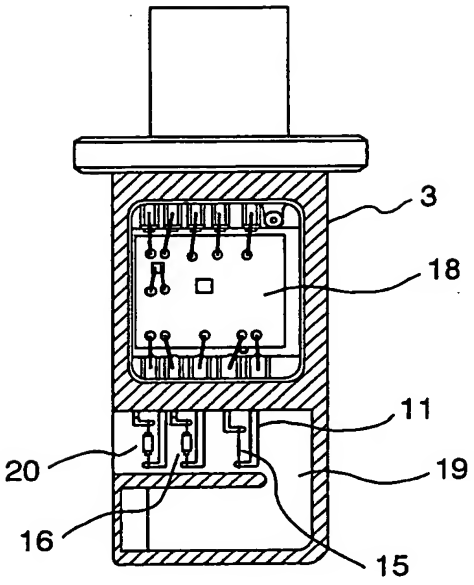


FIG. 4

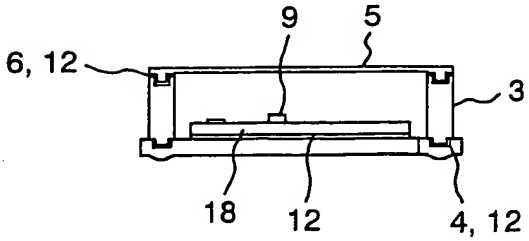


FIG. 5

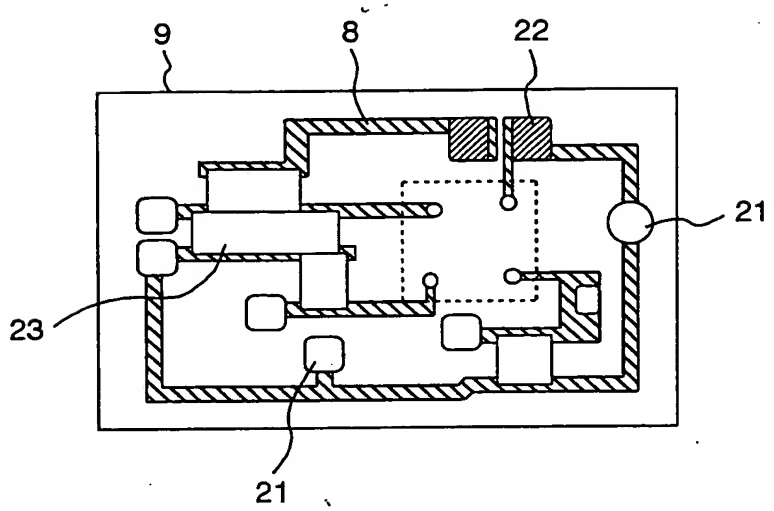


FIG. 6

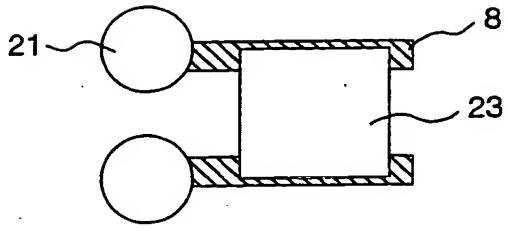


FIG. 7

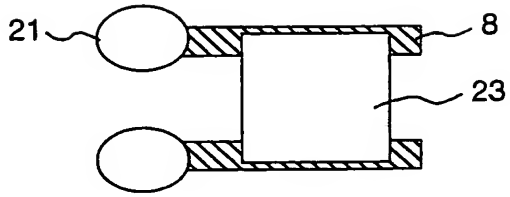


FIG. 8

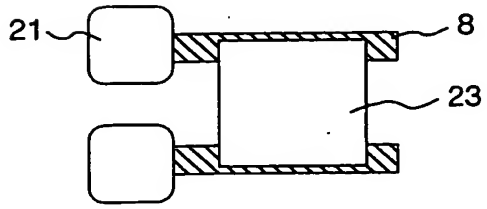


FIG. 9

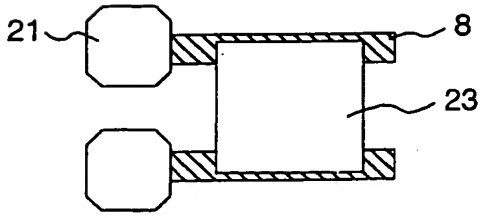


FIG. 10

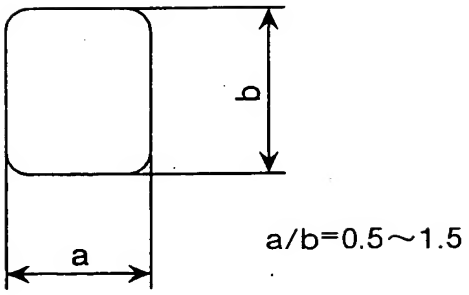


FIG. 11

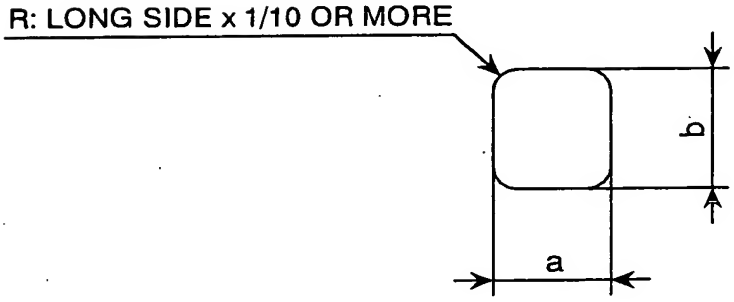


FIG. 12

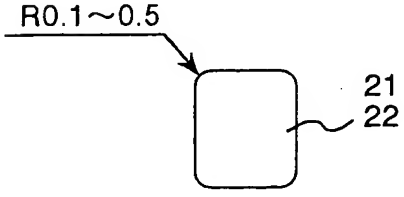


FIG. 13

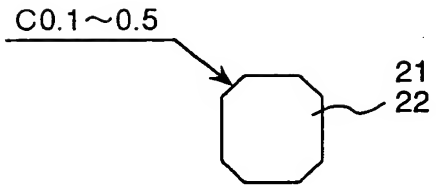


FIG. 14

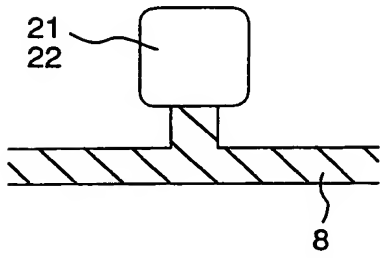


FIG. 15

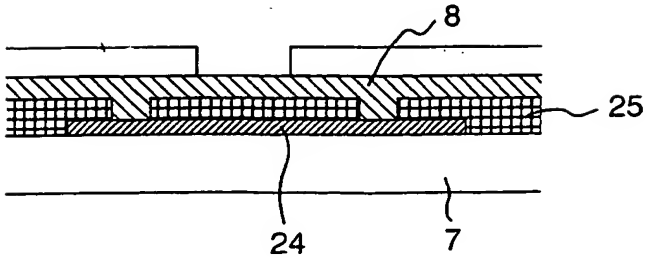


FIG. 16

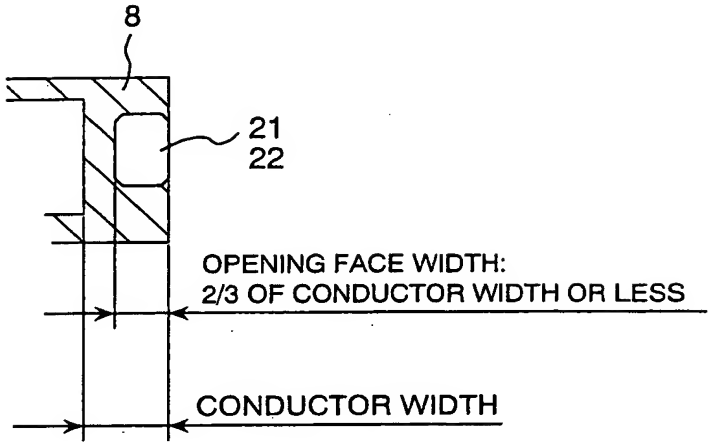

8
21
22
OPENING FACE WIDTH:
2/3 OF CONDUCTOR WIDTH OR LESS
CONDUCTOR WIDTH

FIG. 17

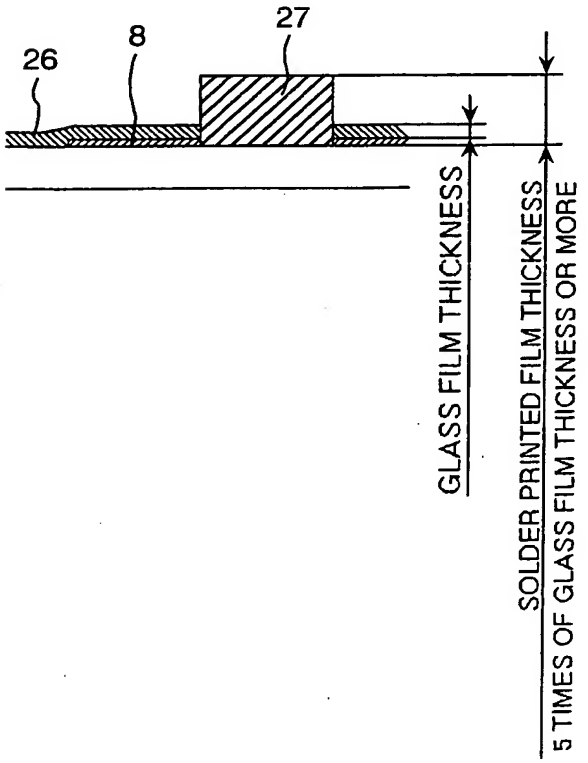
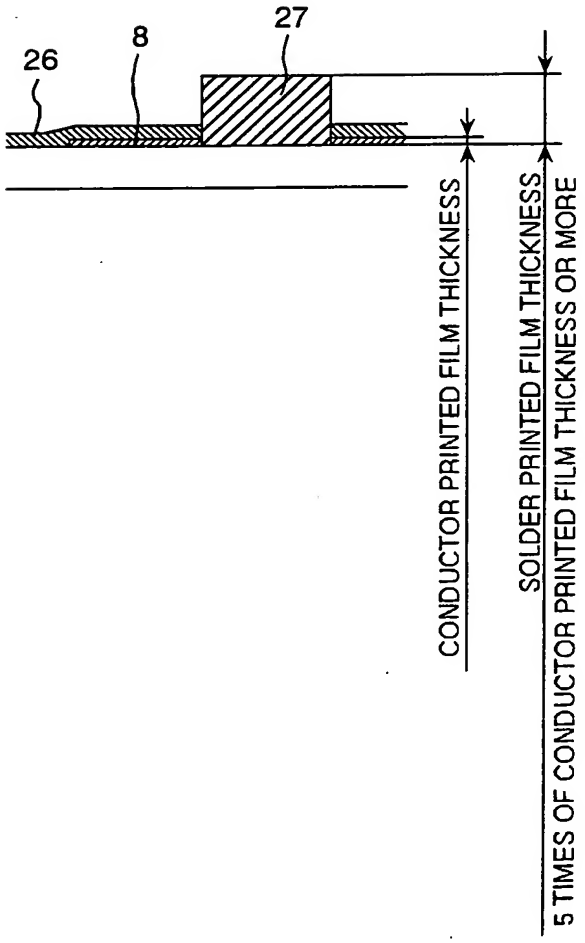

26
8
27
GLASS FILM THICKNESS
SOLDER PRINTED FILM THICKNESS
5 TIMES OF GLASS FILM THICKNESS OR MORE

FIG. 18


26
8
27
CONDUCTOR PRINTED FILM THICKNESS
SOLDER PRINTED FILM THICKNESS
5 TIMES OF CONDUCTOR PRINTED FILM THICKNESS OR MORE